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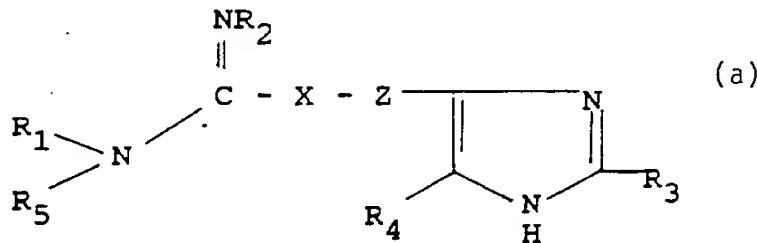
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(54) Title: IMIDAZOLE-DERIVATIVES HAVING AGONISTIC OR ANTAGONISTIC ACTIVITY ON THE HISTAMINE H₃-RECEPTOR



(57) Abstract

The invention relates to imidazole-derivatives of general formula (a). The invention in particular relates to derivatives having agonistic or antagonistic activity on the histamine H₃-receptor. The novel imidazole-derivatives are isothio urea-, guanine- and amidine-derivatives. The invention further relates to pharmaceutical compositions comprising the novel imidazole-derivatives as well as to methods for preparing the derivatives and for preparing pharmaceutical compositions having antagonistic and agonistic activity on the histamine H₃-receptor.

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Imidazole-derivatives having agonistic or antagonistic activity on the histamine H₃-receptor.

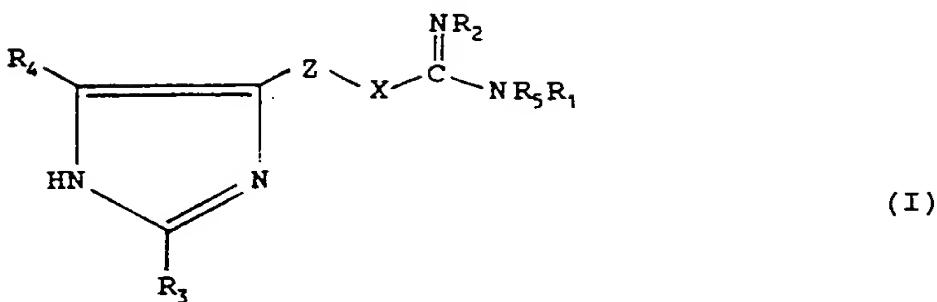
The invention relates to novel imidazole-derivatives. The invention in particular relates to novel imidazole-derivatives having agonistic or antagonistic activity on the histamine H₃-receptor. More in particular it relates to 5 isothiourea-, guanidine- and amidine-derivatives. The invention further relates to the synthesis of such compounds, a pharmaceutical composition comprising such compounds or pharmacological acceptable salts thereof, the use of the compounds as agents having biological activity, as agents 10 with agonistic or antagonistic activity on the histamine H₃-receptor or for preparing a pharmaceutical composition.

In addition to the already longer known histamine H₁- and H₂-receptors there is also a third type histamine-receptor present in the human body, the so-called H₃-receptor. The H₃-receptor is a presynaptic receptor, i.e. it is 15 located on a cell releasing histamine and stimulation of the receptor leads to inhibition of the histamine-release. Furthermore stimulation of the H₃-receptor influences also the release of other neurotransmitters, such as e.g. serotonin and acetylcholine. H₃-receptors are located in the 20 central and peripheral nervous system, the lung tissue, the intestine and probably also in the spleen, the skin and the gastro-intestinal tract. A number of compounds having an effect on H₃-receptors has already been described. For a 25 review see Schwartz et al., Agents and Actions 30, 1/2 (1990) p. 13-23.

Chemical compounds can stimulate or inhibit the histamine H₃-receptor (Timmerman, J. Med. Chem. 33, p. 4-11 (1990)). Now a group of new imidazole-derivatives 30 showing an agonistic or antagonistic activity on the histamine H₃-receptor's has been found.

These derivatives are represented by the general formula:

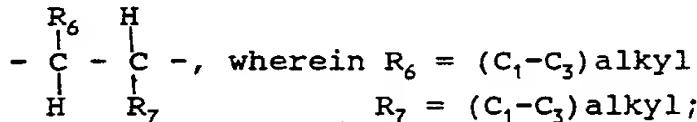
5



10 wherein:

Z is a group of the formula $(CH_2)_m$, wherein m = 1-5 or a group of the formula:

15

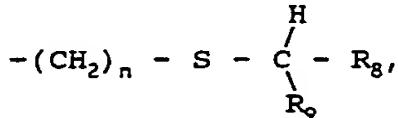


wherein Z may optionally comprise other substituents selected such that the activity of the derivative is not negatively affected,

X represents S, NH or CH_2 ;

20 R_1 represents hydrogen, $(C_1-C_3)\text{alkyl}-$, $\text{aryl}(C_1-C_{10})\text{alkyl}-$, wherein aryl may optionally be substituted, aryl, $(C_5-C_7)\text{cycloalkyl}(C_1-C_{10})\text{alkyl}-$, or a group of the formula:

25



wherein n = 1-4, R_8 is aryl, $\text{aryl}(C_1-C_{10})\text{alkyl}-$, $(C_5-C_7)\text{cycloalkyl}-$ or $(C_5-C_7)\text{cycloalkyl}(C_1-C_{10})\text{alkyl}-$ and R_9 is hydrogen, $(C_1-C_{10})\text{alkyl}-$ or aryl;

30 R_2 and R_5 represent hydrogen, $(C_1-C_3)\text{alkyl}-$, aryl or arylalkyl-, wherein aryl may optionally be substituted;

R_3 represents hydrogen, $(C_1-C_3)\text{alkyl}$, aryl or arylalkyl-, wherein aryl may be substituted; and

35 R_4 represents hydrogen, amino-, nitro-, cyano-, halogen, $(C_1-C_3)\text{alkyl}-$, aryl or arylalkyl-, wherein aryl may optionally be substituted;

wherein aryl is phenyl, substituted phenyl, naphthyl, sub-

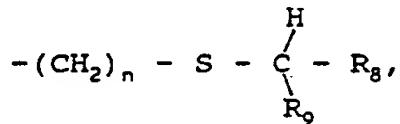
stituted naphthyl, pyridyl or substituted pyridyl; or pharmacological acceptable salts thereof.

Of these compounds the imidazole-derivatives of formula I wherein:

5 A) when Z is a group of the formula $(CH_2)_m$, wherein m = 1-5, and

1) when X is S,

R₁ represents (C_1-C_3) alkyl- or aryl(C_1-C_{10})alkyl-, wherein aryl may optionally be substituted, when m = 1 or 5, or (C_2-C_3) alkyl- or aryl(C_2-C_{10})alkyl-, wherein aryl may optionally be substituted, when m = 2, 3 or 4; aryl, (C_5-C_7) cycloalkyl(C_1-C_{10})alkyl-, or a group of the formula:

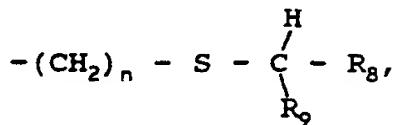


wherein n = 1-4, R₈ is aryl, aryl(C_1-C_{10})alkyl-, (C_5-C_7)cycloalkyl- or (C_5-C_7)cycloalkyl(C_1-C_{10})alkyl- and R₉ is hydrogen, (C_1-C_{10})alkyl- or aryl; R₂ represents hydrogen, (C_1-C_3) alkyl-, aryl or arylalkyl-, wherein aryl may optionally be substituted; and

R₃, R₄ and R₅ represent hydrogen; or

25 2) when X is NH,

R₁ represents hydrogen, (C_1-C_3) alkyl-, aryl, aryl(C_1-C_{10})alkyl-, wherein aryl may optionally be substituted, (C_5-C_7)cycloalkyl(C_1-C_{10})alkyl-, or a group of the formula:



wherein n = 1-4, R₈ is aryl, aryl(C_1-C_{10})alkyl-, (C_5-C_7)cycloalkyl- or (C_5-C_7)cycloalkyl(C_1-C_{10})alkyl- and R₉ is hydrogen or (C_1-C_{10})alkyl-; R₂ represents hydrogen, (C_1-C_3) alkyl-, aryl or arylalkyl-, wherein aryl may be optionally substi-

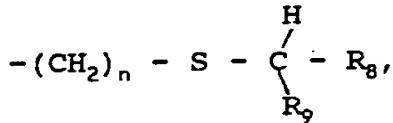
tuted; and

R₃, R₄ and R₅ represent hydrogen; or

3) when X is CH₂,

R₁ represents hydrogen, (C₁-C₃)alkyl-,

5 aryl(C₁-C₁₀)alkyl-, wherein aryl may optionally be substituted, aryl, (C₅-C₇)cycloalkyl(C₁-C₁₀)alkyl-, or a group of the formula:



10

wherein n = 1-4, R₈ is aryl, aryl(C₁-C₁₀)alkyl-, (C₅-C₇)cycloalkyl- or (C₅-C₇)cycloalkyl(C₁-C₁₀)alkyl- and R₉ is hydrogen, (C₁-C₁₀)alkyl- or aryl;

15

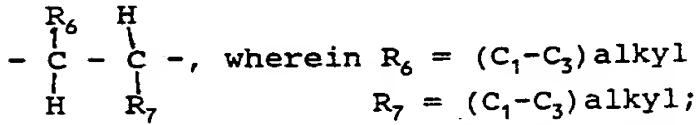
R₂ and R₅ represent hydrogen, (C₁-C₃)alkyl-, aryl or arylalkyl-, wherein aryl may optionally be substituted;

20

R₃ represents hydrogen, (C₁-C₃)alkyl, aryl or arylalkyl-, wherein aryl may be substituted; and

R₄ represents hydrogen, amino-, nitro-, cyano-, halogen, (C₁-C₃)alkyl-, aryl or arylalkyl-, wherein aryl may optionally be substituted;

B) when Z is a group of the formula :



25

R₇ = (C₁-C₃)alkyl;

wherein Z may optionally comprise other substituents selected such that the activity of the derivative is not negatively affected,

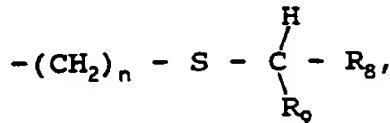
X represents S, NH or CH₂;

30

R₁ represents hydrogen, (C₁-C₃)alkyl-,

aryl(C₁-C₁₀)alkyl-, wherein aryl may optionally be substituted, aryl, (C₅-C₇)cycloalkyl(C₁-C₁₀)alkyl-, or a group of the formula:

35



wherein n = 1 - 4, R₈ is aryl, aryl(C₁-C₁₀)alkyl-,

(C₅-C₇)cycloalkyl- or (C₅-C₇)cycloalkyl(C₁-C₁₀)alkyl- and R₉ is hydrogen, (C₁-C₁₀)alkyl- or aryl;

R₂ and R₅ represent hydrogen, (C₁-C₃)alkyl-, aryl or arylalkyl-, wherein aryl may optionally be substituted; R₃ represents hydrogen, (C₁-C₃)alkyl, aryl or arylalkyl-, wherein aryl may be substituted; and R₄ represents hydrogen, amino-, nitro-, cyano-, halogen, (C₁-C₃)alkyl-, aryl or arylalkyl-, wherein aryl may optionally be substituted;

wherein aryl is phenyl, substituted phenyl, naphthyl, substituted naphthyl, pyridyl or substituted pyridyl, are novel derivatives.

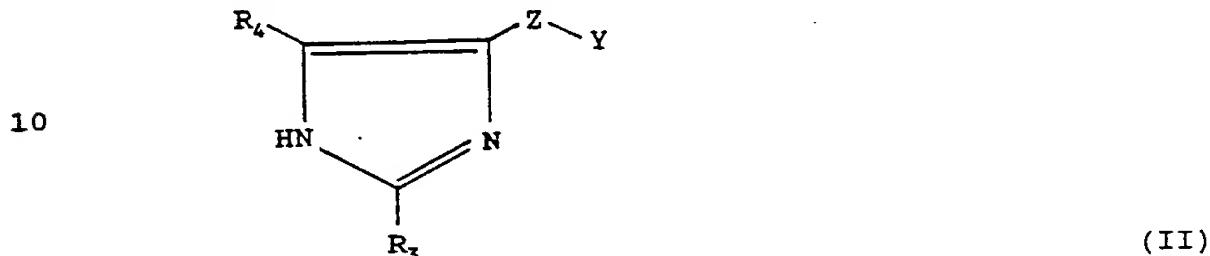
Agonistic activity is in particular shown by compounds of formula I, wherein R₁, R₂, R₃, R₄ and R₅ are hydrogen, m is 2, and X is S or NH. The compound S-[2-(4-imidazolyl)ethyl]isothiourea shows a strong agonistic activity and is therefore preferred as the active ingredient in a pharmaceutical composition having histamine H₃-agonistic activity.

Antagonistic activity is in particular shown by compounds of formula I, wherein R₃, R₄ and R₅ are hydrogen; m is 2 or 3, R₁ is a group of the formula -(CH₂)_nR₁₀, wherein R₁₀ is aryl or substituted aryl, n≥1 and X is S or NH. Preferred compounds are S-[2-(imidazol-4-yl)ethyl]-N-(2-phenylethyl)-isothiourea, N-benzyl-S-[3-(4(5)-imidazolyl)propyl]isothiourea, S-[3-(4(5)-imidazolyl)propyl]-N-(2-phenylethyl)isothiourea, S-[3-(4(5)-imidazolyl)propyl]-N-(3-phenylethyl)isothiourea, S-[3-(4(5)-imidazolyl)propyl]-N-(3-phenylbutyl)isothiourea, S-[3-(4(5)-imidazolyl)propyl]-N-(4-chlorobenzyl)isothiourea, N-cyclohexylmethyl-S-[3-(4(5)-imidazolyl)propyl]isothiourea and S-[3-(4(5)-imidazolyl)propyl]-N-(4-iodophenylethyl)isothiourea.

Other compounds showing strong antagonistic activity are compounds of formula I, wherein R₃, R₄ and R₅ are hydrogen, m is 1, 2 or 3; and R₁ is a group of the formula -(CH₂)_r-S- $\begin{array}{c} \phi \\ | \\ R_{11} \end{array}$.

wherein ϕ is aryl, r is 1, 2 or 3; and R_{11} is hydrogen, (C_1-C_{10})alkyl- or aryl. A preferred compound is N-[2-(benzyl-thio)ethyl]-S-[3-(imidazol-4-yl)propyl]isothiourea.

Compounds of formula I can in general be synthesized in a for analogous compounds known manner. Favourable methods for synthesizing consist in condensation of a imidazole-compound of the general formula:



wherein Y represents Br, OH, or O-alkyl, with a thiourea-
derivative having the general formula:



or condensation of a imidazole of formula II wherein Y represents NH_2 , with a isothiourea-derivative having the general formula:



wherein in the formulas III and IV R represents hydrogen,
10 (C_1-C_{10})alkyl-, aryl(C_1-C_{10})alkyl- or aryl, and R_{12} represents (C_1-C_{10})alkyl. As solvents polair solvents are used such as ethanol or propanol. The condensations are carried out at temperatures between roomtemperature and the boiling point of the solvents for between 30 minutes and 10 hours.

15 Reactions take place in acid environment, e.g. hydrobromic acid, or in neutral environment. The obtained product can be processed in the usual way. If desired it is further possible to convert the obtained compounds of formula I in other compounds of formula I.

The following examples illustrate the synthesis of compounds of the present invention but are never intended to limit the scope thereof.

5

EXAMPLE 1

Synthesis of N-benzyl-S-[2-(imidazol-4-yl)ethyl]isothiourea dipicrate (VUF 9028).

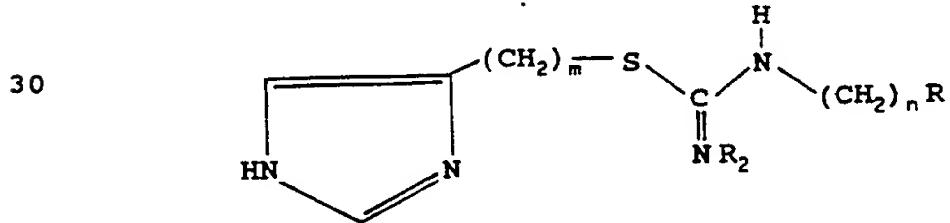
3.5 gram (13.7 mmol) 4(5)-(2-bromoethyl)imidazo-
10 le.HBr and 2.3 gram N-benzylthiourea were refluxed for 60 hours in 30 ml ethanol. The ethanol was evaporated and the product was purified by means of columnchromatography, using methanol/ethylacetate as eluent.

Subsequently the solvent was evaporated and the residue dissolved in methanol whereto 10 gram picric acid in methanol was added. After addition of water an oil was formed, which after stirring with water became solid. The solid matter with melting point 166.9-169.8°C was subsequently filtrated. The NMR-results of this compound are given in table 1.

EXAMPLE 2

Synthesis of S-[3-(4(5)-imidazolyl)alkyl]-N-(2-(substituted)-arylalkyl)isothiourea-derivatives.

Analogous to the preparation method of VUF 9028 from example 1 a number of compounds were synthesized with the formula:



35 The meaning of n, m and R, the solvent of the condensation reaction and the melting points of the compounds are given in the table below. The NMR-results are given in table 1.

	Compound	R ₂	R	n	m	melt.point	salt	solvent
	VUF 8397	H	C ₆ H ₅	0	2	174-176°C	2HBr	2-prop.
5	VUF 9029	H	C ₆ H ₅	2	2	177-185°C	2HBr	eth.
	VUF 9030	H	C ₆ H ₅	3	2	152-155°C	dipicr.	eth.
	VUF 9031	H	C ₆ H ₅	4	2	136-139°C	2HBr	eth.
	VUF 9051	CH ₃	C ₆ H ₅	2	2	152-156°C	2HBr	eth.
10	VUF 9107	H	C ₆ H ₅	1	3	155-160°C	2HBr	eth.
	VUF 9151	H	C ₆ H ₅	2	3	178-183°C	2HBr	eth.
	VUF 9152	H	C ₆ H ₅	3	3	177-184°C	2HBr	eth.
	VUF 9153	H	4-ClC ₆ H ₄	1	3	200-205°C	2HBr	eth.
	VUF 9163	H	c-C ₆ H ₁₁	1	3	137-153°C	dipicr.	eth.
	VUF 4571	H	C ₆ H ₅	4	3	112-134°C	dipicr.	eth.
15	VUF 4586	H	4-IC ₆ H ₄ *	2	3	188-190°C	2HBr	2-prop.

* Radioactively labeled compound, e.g. for use as a tracer-molecule

20 EXAMPLE 3

Synthesis of N-[2-(imidazol-4-yl)ethyl]-N'-phenyl guanidine dipicrate (VUF 9006).

Step 1:

25 Synthesis of S-ethyl-N-phenylisothiourea.

4 gram N-phenylisothiourea (33 mmol) and 5 ml ethylbromide were refluxed for 10 hours in ethanol. Again 5 ml ethylbromide was added. The reaction course was followed by thin layer chromatography (ethylacetate/petroleumether 3:7).

30 Subsequently the solvent was evaporated and the residue crystallised from ethanol/ethylacetate.

Step 2:

15 mmol histamine.2HCl was added to 30 mmol sodiummethanolate in ethanol (prepared by dissolving 30 mmol sodium in ethanol). Subsequently it was refluxed for one half hour, after which the mixture was cooled in ice and the formed NaCl was

filtrated.

To the filtrate 15 mmol S-ethyl-N-phenylisothiourea was added. Next the reation mixture was refluxed for 35 hours (control with thin layer chromatography (ethylacetate/petroleumether 1:1, saturated with ammonia)). Subsequently the solvent was evaporated and the residue dissolved in methanol. 35 mmol picric acid were added. The product was seperated by the addition of water and was subsequently crystallised from methanol/water. The melting point was 235-238°C.

Analogous to the synthesis of VUF 9006 N-[2-(imidazol-4-yl)ethyl]-N'-phenyl-ethylguanidine dipicrate (VUF 9007; meltingpoint 196-198°C) was prepared.

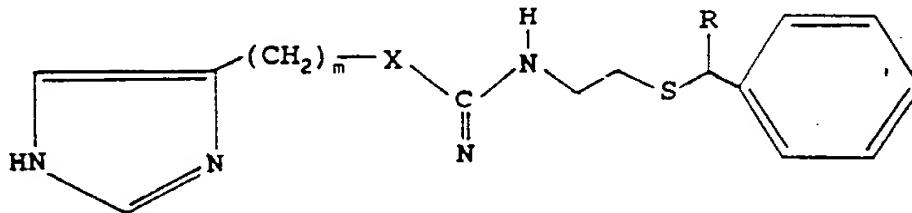
The NMR-resluts are given in table 1.

EXAMPLE 4

Synthesis of N-[2-(arylalkylthio)alkyl]-S-[3-(imidazol-4-yl)alkyl]isothiourea- and -guanidine-derivatives.

Analogous to example 1 compounds were synthesized having the formula:

25



30 The meaning of the symbols m, X and R, the solvent of the condensation reaction and the melting points of the compounds are given in the table below. The NMR-results are given in table 1.

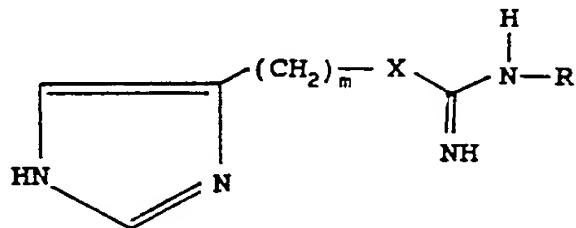
Compounds	m	X	R	melting point	salt	solvent
VUF 8404	2	S	H	233-235°C	2HBr	2-prop.
VUF 8405	3	NH	H	145-148°C	dipicr.	ethanol
VUF 8409	2	S	C ₆ H ₅	106-109°C	dipicr.	ethanol
VUF 8414	3	S	H	126-133°C	dipicr.	ethanol

10

EXAMPLE 5

Synthesis of N-alkyl-S-[2-(4-imidazolyl)alkyl]isothiourea-
15 and -guanidine-derivatives.

Analogous to example 1 compounds were synthesized
having the formula:



The meaning of the symbols m, X and R, the solvent of the
25 condensation reaction and the melting points of the com-
pounds are given in the table below. The NMR-results are
given in table 1.

Compound	m	X	R	melting point	salt	solvant
VUF 8325	2	S	H	210-212°C	2HBr	eth.
VUF 83100	2	NH	H	222-223°C	2HCl	eth.
VUF 8621	2	S	CH ₃	180-181°C	2HBr	water

35

TABLE 1. NMR-results of the compounds mentioned in the description.

<u>COMPOUNDS</u>				
<u>AGONISTS</u>				
5	<u>VUF8325</u>			
	3.06 ppm	triplet	J = 7.0 Hz	2H
	3.56 ppm	triplet	J = 7.0 Hz	2H
	7.61 ppm	singlet		1H
	9.01-9.27 ppm	multiplet		5H
10	<u>VUF8621</u>			
	2.93 ppm	singlet		3H
	3.07 ppm	triplet	J = 6.8 Hz	2H
	3.59 ppm	triplet	J = 6.8 Hz	2H
	7.60 ppm	singlet		1H
15	9.11 ppm	doublet	J = 1.3 Hz	1H
<u>ANTAGONISTS</u>				
	<u>VUF9028</u>			
	3.06 ppm	triplet	J = 6.9	2H
	3.54 ppm	triplet	J = 6.9	2H
20	4.58 ppm	singlet		2H
	7.29-7.49 ppm	multiplet		6H
	7.52 ppm	singlet		4H
	8.62 ppm	singlet		1H
	9.08 ppm	doublet	J = 1.3 Hz	1H
25	<u>VUF9029</u>			
	2.90 ppm	triplet	J = 7.5 Hz	2H
	3.00 ppm	triplet	J = 7.0 Hz	2H
	3.50-3.69 ppm	multiplet		4H
	7.21-7.35 ppm	multiplet		5H
30	7.58 ppm	singlet		1H
	9.16 ppm	doublet	J = 1.3 Hz	1H
	<u>VUF9030</u>			
	1.86 ppm	quintet	J = 7.4 Hz	2H
	2.62 ppm	triplet	J = 7.4 Hz	2H
35	3.05 ppm	triplet	J = 6.9 Hz	2H
	3.24-3.38 ppm	multiplet		2H
	3.51 ppm	triplet	J = 6.9 Hz	2H
	7.16-7.39 ppm	multiplet		5H
	7.53 ppm	singlet		1H
40	8.61 ppm	singlet		4H
	9.06 ppm	doublet	J = 1.3 Hz	1H
	<u>VUF9031</u>			
	1.45-1.71 ppm	multiplet		4H
	2.60 ppm	triplet		2H
45	3.05 ppm	triplet	J = 6.8 Hz	2H
	3.30-3.45 ppm	multiplet		2H
	3.60 ppm	triplet	J = 6.8 Hz	2H
	7.13-7.46 ppm	multiplet		5H
	7.60 ppm	singlet		1H
50	9.13 ppm	doublet	J = 1.4 Hz	1H
	<u>VUF9051</u>			
	2.80-3.06 ppm	multiplet		4H
	3.50-3.68 ppm	multiplet		4H
	7.18-7.40 ppm	multiplet		5H
55	7.57 ppm	singlet		1H
	9.09 ppm	singlet		1H

SUBSTITUTE SHEET

11/2.

	<u>VUF9006</u>			
	2.90 ppm	triplet	J = 6.3 Hz	2H
	3.51 ppm	triplet	J = 6.3 Hz	2H
	7.14-7.50 ppm	multiplet		5H
5	7.69-7.86 ppm	multiplet		2H
	8.59 ppm	singlet		4H
	8.97 ppm	singlet		1H
	<u>VUF9007</u>			
10	2.74-2.92 ppm	multiplet		4H
	3.32-3.51 ppm	multiplet		4H
	7.18-7.50 ppm	multiplet		6H
	8.63 ppm	singlet		4H
	9.05 ppm	doublet		1H
	<u>VUF8404</u>			
15	2.66 ppm	triplet	J = 6.3 Hz	2H
	3.06 ppm	triplet	J = 6.3 Hz	2H
	3.40-3.72 ppm	multiplet		4H
	3.81 ppm	singlet		2H
	7.28 ppm	singlet		5H
20	7.58 ppm	singlet		1H
	9.07 ppm	doublet	J = 0.8 Hz	1H
	<u>VUF8405</u>			
	1.64 ppm	quintet	J = 7.2 Hz	2H
	2.38-2.84 ppm	multiplet		4H
25	3.06-3.56 ppm	multiplet		4H
	3.80 ppm	singlet		2H
	7.26-7.44 ppm	multiplet		6H
	8.60 ppm	singlet		4H
	9.02 ppm	singlet		1H
30	<u>VUF8409</u>			
	2.56 ppm	triplet	J = 6.8 Hz	2H
	3.03 ppm	triplet	J = 6.8 Hz	2H
	3.26-3.70 ppm	multiplet		4H
	5.40 ppm	singlet		1H
35	7.10-7.56 ppm	multiplet		11H
	8.60 ppm	singlet		4H
	9.02 ppm	singlet		1H
	<u>VUF8414</u>			
40	1.94 ppm	quintet	J = 6.8 Hz	2H
	2.60-2.94 ppm	multiplet		4H
	3.20 ppm	triplet	J = 6.8 Hz	2H
	3.30-3.68 ppm	multiplet		2H
	3.78 ppm	singlet		2H
	7.28-7.42 ppm	multiplet		6H
45	8.60 ppm	singlet		4H
	9.00 ppm	doublet	J = 1.0 Hz	1H
	<u>VUF9107</u>			
	1.86-2.05 ppm	multiplet		2H
	2.76 ppm	triplet	J = 7.5 Hz	2H
50	3.20-3.51 ppm	multiplet		7H
	4.60 ppm	singlet		2H
	7.26-7.52 ppm	multiplet		6H
	9.01 ppm	doublet	J = 1.3 Hz	1H
	<u>VUF9151</u>			
55	1.81-1.98 ppm	multiplet		2H
	2.73 ppm	triplet	J = 7.5 Hz	2H

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	2.89 ppm	triplet	J = 7.0 Hz	2H
	3.22 ppm	triplet	J = 7.0 Hz	2H
	3.34 ppm	singlet		6H
	3.52-3.68 ppm	multiplet		2H
5	7.20-7.40 ppm	multiplet		5H
	7.48 ppm	singlet		1H
	9.02 ppm	doublet	J = 1.3 Hz	1H
	<u>VUF9152</u>			
10	1.78-2.06 ppm	multiplet		4H
	2.64 ppm	triplet	J = 7.6 Hz	2H
	2.77 ppm	triplet	J = 7.3 Hz	2H
	3.19-3.50 ppm	multiplet		10H
	7.18-7.40 ppm	multiplet		5H
	7.49 ppm	singlet		1H
15	9.01 ppm	doublet	J = 1.3H	1H
	<u>VUF9153</u>			
20	1.86-2.06 ppm	multiplet		2H
	2.77 ppm	triplet	J = 7.2 Hz	2H
	3.22-3.49 ppm	multiplet		6H
	4.60 ppm	singlet		2H
	7.32-7.58 ppm	multiplet		6H
	9.04 ppm	doublet	J = 1.3H	1H
	<u>VUF9163</u>			
25	0.80-1.77 ppm	multiplet		11H
	1.86-2.03 ppm	multiplet		2H
	2.74 ppm	triplet	J = 7.0 Hz	2H
	3.08-3.25 ppm	multiplet		4H
	3.35 ppm	singlet		10H
	7.46 ppm	singlet		1H
30	8.49 ppm	singlet		4H
	8.98 ppm	doublet	J = 1.3H	1H
	<u>VUF4571</u>			
35	1.47-1.70 ppm	multiplet		4H
	1.84-2.03 ppm	multiplet		2H
	2.42-2.66 ppm	multiplet		50H
	2.74 ppm	triplet	J = 7.2 Hz	2H
	3.19 ppm	triplet	J = 7.2 Hz	2H
	3.26-3.38 ppm	multiplet		2H
40	3.46 ppm	multiplet		10H
	7.11-7.35 ppm	multiplet		5H
	7.47 ppm	singlet		1H
	8.59 ppm	singlet		4H
	<u>VUF4586</u>			
45	1.89 ppm	multiplet		2H
	2.74 ppm	triplet	J = 7.2 Hz	2H
	2.83 ppm	triplet	J = 7.0 Hz	2H
	3.24 ppm	multiplet		2H
	3.57 ppm	multiplet	J = 7.2 Hz	2H
	7.05-7.20 ppm	multiplet		2H
50	7.60-7.75 ppm	multiplet		2H
	7.50 ppm	singlet		1H
	9.03 ppm	singlet		1H

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Pharmacological experiments

The agonistics and antagonistics activities on the H₃-receptor of the various compounds were determined compared to histamine. The testmethods used therefor are described in
5 Van der Werf et al., Agents and Actions 20, 3/4 (1987)
p. 239-243 and Menkfeld et al., European Journal of Pharmacology, 186 (1990) p. 343-347.

The results of the experiments are given in the tables below. pD₂ is the negative logarithm of the concentration of the testcompound at which 50% agonistic activity was measured. pA₂ is the negative logarithm of the concentration of the testcompound at which the concentration of the agonist had to be doubled to obtain the same effect as obtained when the antagonist was absent.

15 Pharmaceutical compositions, comprising compounds of formula I as defined in claim 19 as the active ingredient for therapeutically influencing the human and animal histaminergic system have the form of powders, suspensions, solutions, sprays, emulsions, unguents or creams and can be used
20 for local application, intranasal, rectal, vaginal and also for oral or parenteral (intravenous, intradermal, intramuscular, intrathecal etc.) administration. Such compositions can be prepared by combining (i.e. by mixing, dissolving etc.) of the active compound of formula I in the form of a
25 free acid or salt with pharmaceutically acceptable excipients with neutral character (such as aquous or non-aquous solvents, stabilizers, emulsifiers, detergents, additives), and further if neccesary colouring agents and flavouring agents. The concentration of the active ingredient in a pharmaceuti-
30 cal composition can vary between 0.1% and 100%, depending on the nature of the influence and the method of administra-
tion. The dose of the active ingredient that is administered can further be varied between 0.1 mg and 100 mg per kg body-weight.

TABLE 2. Antagonistic activity

Compound	pA ₂	testmethod
VUF 8397	7.0	ratcortex
VUF 9028	7.8	ileum guinea pig
VUF 9029	8.0	ileum guinea pig
VUF 9030	7.6	ileum guinea pig
10 VUF 9031	7.7	ileum guinea pig
VUF 9051	7.8	ileum guinea pig
VUF 9006	5.8	ileum guinea pig
VUF 9007	6.3	ileum guinea pig
VUF 8404	7.4	ileum guinea pig
15 VUF 8405	7.9	ileum guinea pig
VUF 8409	6.6	ileum guinea pig
VUF 8414	8.6	ileum guinea pig
VUF 9107	8.8	ileum guinea pig
VUF 9151	8.8	ileum guinea pig
20 VUF 9152	8.3	ileum guinea pig
VUF 9153	9.9	ileum guinea pig
VUF 9163	8.8	ileum guinea pig
VUF 4571	8.4	ileum guinea pig
VUF 4586	9.2	ileum guinea pig

25

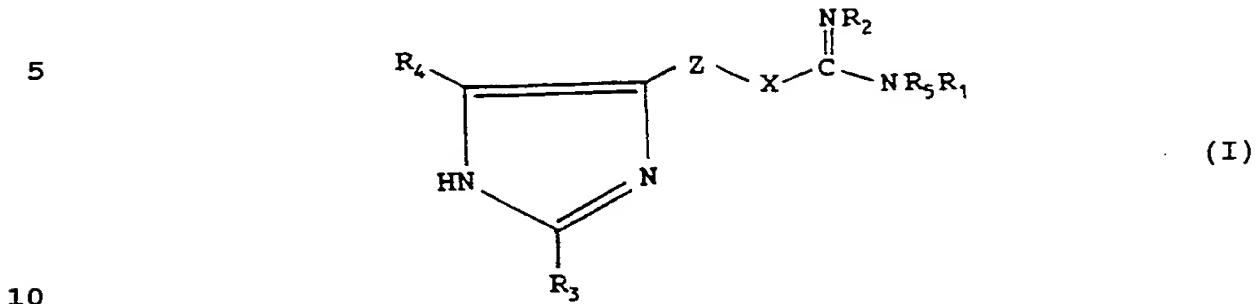
TABLE 3. Agonistic activity

Compound	pD ₂	testmethod
VUF 8325	9.3	ratcortex
VUF 8325	8.1	ileum guinea pig
VUF 83100	7.4	ratcortex
30 VUF 8621	7.3	ileum guinea pig

35

C L A I M S

1. Imidazole-derivatives of the general formula:

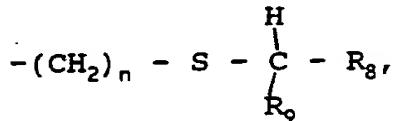


wherein:

A) when Z is a group of the formula $(CH_2)_m$, wherein $m = 1-5$,
and

1) when X is S,

15 R₁ represents (C_1-C_3) alkyl- or aryl(C_1-C_{10})alkyl-,
wherein aryl may optionally be substituted, when
 $m = 1$ or 5 , or (C_2-C_3) alkyl- or aryl(C_2-C_{10})
alkyl-, wherein aryl may optionally be substi-
ted, when $m = 2$, 3 or 4 ;
20 aryl, (C_5-C_7) cycloalkyl(C_1-C_{10})alkyl-, or a
group of the formula:

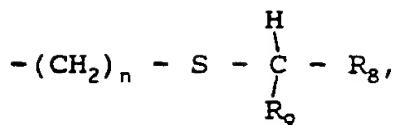


25 wherein $n = 1-4$, R₈ is aryl, aryl(C_1-C_{10})alkyl-,
 (C_5-C_7) cycloalkyl- or (C_5-C_7) cycloalkyl(C_1-C_{10})al-
kyl- and R₉ is hydrogen, (C_1-C_{10}) alkyl- or aryl;
R₂ represents hydrogen, (C_1-C_3) alkyl-, aryl or
arylalkyl-, wherein aryl may optionally be substi-
tuted; and

R₃, R₄ and R₅ represent hydrogen; or

2) when X is NH,

30 R₁ represents hydrogen, (C_1-C_3) alkyl-, aryl,
aryl(C_1-C_{10})alkyl-, wherein aryl may optionally be
substituted, (C_5-C_7) cycloalkyl(C_1-C_{10})alkyl-, or a
group of the formula:



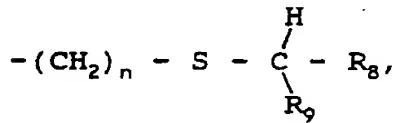
wherein n = 1-4, R₈ is aryl, aryl(C₁-C₁₀)alkyl-, (C₅-C₇)cycloalkyl- or (C₅-C₇)cycloalkyl(C₁-C₁₀)alkyl- and R₉ is hydrogen or (C₁-C₁₀)alkyl-; R₂ represents hydrogen, (C₁-C₃)alkyl-, aryl or arylalkyl-, wherein aryl may be optionally substituted; and

10 R_3 , R_4 and R_5 represent hydrogen; or

3) when X is CH_3 ,

R₁ represents hydrogen, (C₁-C₃)alkyl-, aryl(C₁-C₁₀)alkyl-, wherein aryl may optionally be substituted, aryl, (C₅-C₇)cycloalkyl(C₁-C₁₀)alkyl-, or a group of the formula:

15 or a group of the formula:

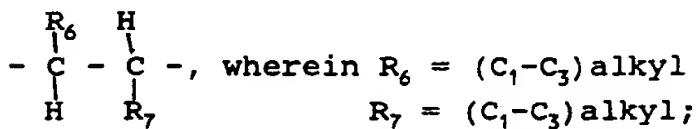


wherein n = 1-4, R₈ is aryl, aryl(C₁-C₁₀)alkyl-, (C₅-C₇)cycloalkyl- or (C₅-C₇)cycloalkyl(C₁-C₁₀)alkyl- and R₉ is hydrogen, (C₁-C₁₀)alkyl- or aryl;

R_2 and R_5 represent hydrogen, (C_1-C_3)alkyl-, aryl or arylalkyl-, wherein aryl may optionally be substituted;

25 R₃ represents hydrogen, (C₁-C₃)alkyl, aryl or
arylalkyl-, wherein aryl may be substituted; and
R₄ represents hydrogen, amino-, nitro-, cyano-,
halogen, (C₁-C₃)alkyl-, aryl or arylalkyl-,
wherein aryl may optionally be substituted;

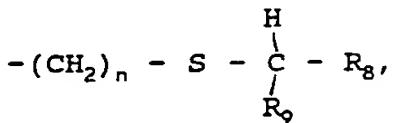
30 B) when Z is a group of the formula :



wherein Z may optionally comprise other substituents selected such that the activity of the derivative is not negatively affected,
X represents S, NH or CH₂;

R₁ represents hydrogen, (C₁-C₃)alkyl-, aryl(C₁-C₁₀)alkyl-, wherein aryl may optionally be substituted, aryl, (C₅-C₇)cycloalkyl(C₁-C₁₀)alkyl-, or a group of the formula:

5



10

wherein n = 1 - 4, R₈ is aryl, aryl(C₁-C₁₀)alkyl-, (C₅-C₇)cycloalkyl- or (C₅-C₇)cycloalkyl(C₁-C₁₀)alkyl- and R₉ is hydrogen, (C₁-C₁₀)alkyl- or aryl;

15 R₂ and R₅ represent hydrogen, (C₁-C₃)alkyl-, aryl or arylalkyl-, wherein aryl may optionally be substituted; R₃ represents hydrogen, (C₁-C₃)alkyl, aryl or arylalkyl-, wherein aryl may be substituted; and R₄ represents hydrogen, amino-, nitro-, cyano-, halogen, (C₁-C₃)alkyl-, aryl or arylalkyl-, wherein aryl may optionally be substituted;

wherein aryl is phenyl, substituted phenyl, naphthyl, substituted naphthyl, pyridyl or substituted pyridyl.

20

2. Imidazole-derivatives according to claim 1, having the formula I, wherein R₃, R₄ and R₅ are hydrogen; m is 2; R₁ is a group of the formula (CH₂)_nR₁₀ wherein R₁₀ is a substituted or non-substituted arylgroup, n≥1; and X is S or NH.

25

3. Imidazole-derivatives according to claim 2, characterized in that R₂ is hydrogen; m is 2; and X is S.

4. Imidazole-derivatives according to claim 3, characterized in that the derivative is S-[2-(imidazol-4-yl)ethyl]-N-(2-phenylethyl)isothiourea.

30

5. Imidazole-derivatives according to claim 2, characterized in that R₂ is hydrogen; m is 3; and X is S.

6. Imidazole-derivatives according to claim 5, characterized in that the derivative is N-benzyl-S-[3-(4(5)-imidazolyl)propyl]isothiourea.

35

7. Imidazole-derivatives according to claim 5, characterized in that the derivative is S-[3-(4(5)-imidazolyl)propyl]-N-(2-phenylethyl)isothiourea.

8. Imidazole-derivatives according to claim 5,
characterized in that the derivative is S-[3-(4(5)-imidazolyl)propyl]-N-(3-phenylpropyl)isothiourea.

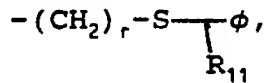
9. Imidazole-derivatives according to claim 5,
5 characterized in that the derivative is S-[3-(4(5)-imidazolyl)propyl]-N-(4-phenylbutyl)isothiourea.

10. Imidazole-derivatives according to claim 5,
characterized in that the derivative is S-[3-(4(5)-imidazolyl)propyl]-N-(4-chlorobenzyl)isothiourea.

11. Imidazole-derivatives according to claim 5,
characterized in that the derivative is N-cyclohexylmethyl-S-[3-(4(5)-imidazolyl)propyl]isothiourea.

12. Imidazole-derivatives according to claim 5,
characterized in that the derivative is S-[3-(4(5)-imidazolyl)propyl]-N-(4-iodophenylethyl)isothiourea.

13. Imidazole-derivatives according to claim 1,
having the formula I, wherein R₃, R₄ and R₅ are hydrogenatoms;
m is 1, 2 or 3; R₁ is a group of the formula



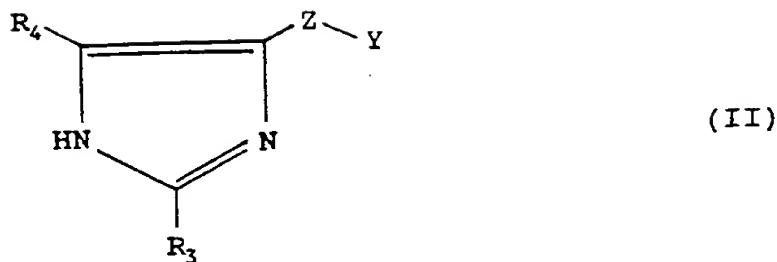
20 wherein φ is an arylgroup, r is 1, 2 or 3 and R₁₁ is hydrogen, (C₁-C₁₀)alkyl- or aryl.

14. Imidazole-derivatives according to claim 13,
characterized in that m is 3, r is 2, R₁₁ is hydrogen and X
25 is S or NH.

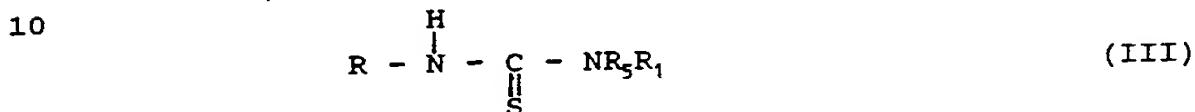
15. Imidazole-derivatives according to claim 14,
characterized in that the derivative is N-[2-(benzylthio)-ethyl]-S-[3-(imidazol-4-yl)propyl]isothiourea.

16. Method for preparing imidazole-derivatives,
30 characterized in that compounds of formula I are being
synthesized in a for analogous compounds known manner.

17. Method for preparing imidazole-derivatives,
characterized in that compounds of formula I are prepared by
condensation of an imidazole-derivative of the general
35 formula:

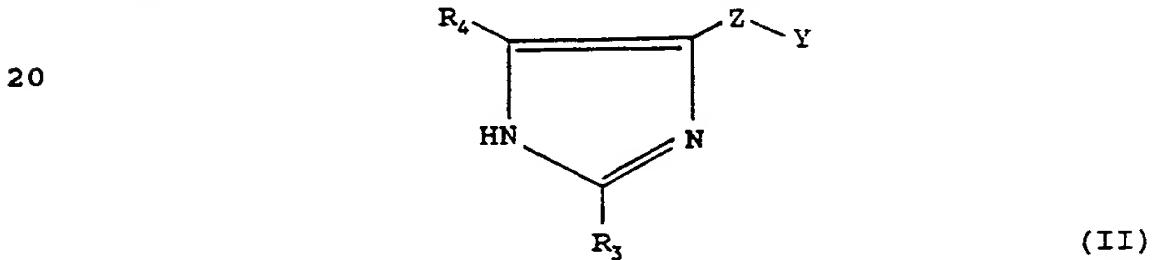


wherein Y represents Br, OH, or O-alkyl; and a thioureade-
rivative of the general formula:



wherein R represents hydrogen, ($\text{C}_1\text{-C}_{10}$) alkyl,
aryl($\text{C}_1\text{-C}_{10}$) alkyl- or aryl, and R_5R_1 represents ($\text{C}_1\text{-C}_{10}$) alkyl-.

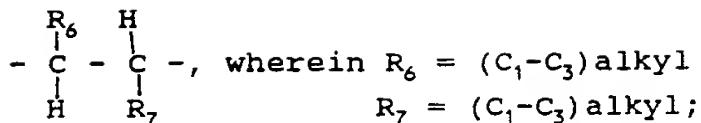
15 18. Method for preparing imidazole-derivatives
according to claim 17, characterized in that compounds of
formula I are being prepared by condensation of an imidazo-
le-derivative of the general formula:



25 wherein Y represents NH_2 ; and a thioureaderivative of the
general formula



19. Pharmaceutical composition having antagonistic
or agonistic activity on the histamine H_3 -receptor, characte-
rized in that it comprises as an active ingredient a com-
35 pound of formula I, wherein :
Z is a group of the formula $(\text{CH}_2)_m$, wherein m = 1-5 or a
group of the formula:



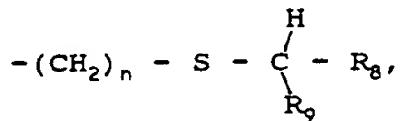
wherein Z may optionally comprise other substituents
 5 selected such that the activity of the derivative is not negatively affected,

X represents S, NH or CH₂;

R₁ represents hydrogen, (C₁-C₃)alkyl-,

aryl(C₁-C₁₀)alkyl-, wherein aryl may optionally be sub-

10 stituted, aryl, (C₅-C₇)cycloalkyl(C₁-C₁₀)alkyl-, or a group of the formula:



15 wherein n = 1-4, R₈ is aryl, aryl(C₁-C₁₀)alkyl-, (C₅-C₇)cycloalkyl- or (C₅-C₇)cycloalkyl(C₁-C₁₀)alkyl- and R₉ is hydrogen, (C₁-C₁₀)alkyl- or aryl;

R₂ and R₅ represent hydrogen, (C₁-C₃)alkyl-, aryl or arylalkyl-, wherein aryl may optionally be substituted;

20 R₃ represents hydrogen, (C₁-C₃)alkyl, aryl or arylalkyl-, wherein aryl may be substituted; and

R₄ represents hydrogen, amino-, nitro-, cyano-, halogen, (C₁-C₃)alkyl-, aryl or arylalkyl-, wherein aryl may optionally be substituted;

25 wherein aryl is phenyl, substituted phenyl, naphthyl, substituted naphthyl, pyridyl or substituted pyridyl; or pharmacological acceptable salts thereof.

20. Pharmaceutical composition according to claim 19, characterized in that it comprises as the active ingredient a compound of formula I or pharmacological acceptable salts thereof, wherein R₁, R₂, R₃, R₄ and R₅ are hydrogen-atoms; m is 2; and X is S or NH.

21. Pharmaceutical composition according to claim 20, characterized in that it comprises as the active ingredient S-[2-(4-imidazolyl)ethyl]isothiourea or a pharmacological acceptable salt thereof.

22. Pharmaceutical composition according to claim

19, characterized in that it comprises as the active ingredient a compound of the formula I or pharmacological acceptable salts thereof, wherein R₃, R₄ and R₅ are hydrogen atoms; m is 2; R₁ is a group of the formula (CH₂)_nR₁₀, wherein R₁₀ is 5 a substituted or non-substituted aryl, n ≥ 1 and X is S or NH.

23. Pharmaceutical composition according to claim 22, characterized in that it comprises as the active ingredient a compound of the formula I or pharmacological acceptable salts thereof, wherein R₂ is hydrogen; m is 2; and X is 10 S.

24. Pharmaceutical composition according to claim 23, characterized in that it comprises as the active ingredient S-[2-(imidazol-4-yl)ethyl]-N-(2-phenylethyl)isothiourea or a pharmacological acceptable salt thereof. 15

25. Pharmaceutical composition according to claim 23, characterized in that it comprises as the active ingredient a compound of the formula I or pharmacological acceptable salts thereof, wherein R₂ is hydrogen; m is 3; and X is 20 S.

26. Pharmaceutical composition according to claim 25, characterized in that it comprises as the active ingredient the derivative is N-benzyl-S-[3-(4(5)-imidazolyl)propyl]isothiourea or a pharmacological acceptable salt there- 25 of.

27. Pharmaceutical composition according to claim 25, characterized in that it comprises as the active ingredient the derivative S-[3-(4(5)-imidazolyl)propyl]-N-(2-phenylethyl)isothiourea or a pharmacological acceptable salt 30 thereof.

28. Pharmaceutical composition according to claim 25, characterized in that it comprises as the active ingredient the derivative S-[3-(4(5)-imidazolyl)propyl]-N-(3-phenylpropyl)isothiourea or a pharmacological acceptable 35 salt thereof.

29. Pharmaceutical composition according to claim 25, characterized in that it comprises as the active ingre-

dient the derivative S-[3-(4(5)-imidazolyl)propyl]-N-(4-phenylbutyl)isothiourea or a pharmacological acceptable salt thereof.

30. Pharmaceutical composition according to claim
5 25, characterized in that it comprises as the active ingredient the derivative S-[3-(4(5)-imidazolyl)propyl]-N-(4-chlorobenzyl)isothiourea or a pharmacological acceptable salt thereof.

31. Pharmaceutical composition according to claim
10 25, characterized in that it comprises as the active ingredient the derivative N-cyclohexylmethyl-S-[3-(4(5)-imidazolyl)propyl]isothiourea or a pharmacological acceptable salt thereof.

32. Pharmaceutical composition according to claim
15 25, characterized in that it comprises as the active ingredient the derivative S-[3-(4(5)-imidazolyl)propyl]-N-(4-iodophenylethyl)isothiourea or a pharmacological acceptable salt thereof.

33. Pharmaceutical composition according to claim
20 19, characterized in that it comprises as the active ingredient a compound of the formula I or pharmacological acceptable salts thereof, wherein R₃, R₄ and R₅ are hydrogen; m is 1-3; R₁ a group is of the formula -(CH₂)_r-S— $\begin{array}{c} \phi \\ | \\ R_{11} \end{array}$
25 wherein φ is aryl, r is 1, 2 or 3 and R₁₁ is hydrogen, (C₁-C₁₀)alkyl- or aryl.

34. Pharmaceutical composition according to claim
33, characterized in that m is 3, r is 2, R₁₁ is hydrogen and X is S or NH.

30 35. Pharmaceutical composition according to claim
34, characterized in that it comprises as the active ingredient N-[2-(benzylthio)ethyl]-S-[3-(imidazole-4-yl)propyl]-isothiourea or a pharmacological acceptable salt thereof.

36. Use of compounds of formula I as defined in
35 claim 1 as an agent having biological activity.

37. Use of compounds of formula I as defined in
claim 19 as an agent having agonistic or antagonistic acti-

vity on the histamine H₃-receptor.

38. Use of a compound of the formula I as defined in claim 19 for preparing a pharmaceutical composition having agonistic or antagonistic activity on the histamine H₃-5 receptor.

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/NL 92/00041

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all)⁶

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.C1. 5 C07D233/64;	A61K31/415;	C07D233/94;	C07D233/95
C07D233/90;	C07D233/68;	C07D401/04;	C07D401/12

II. FIELDS SEARCHED

Minimum Documentation Searched⁷

Classification System	Classification Symbols
Int.C1. 5	C07D ; A61K

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched⁸III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹

Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	DE,A,2 052 692 (SMITH KLINE & FRENCH LABORATORIES LIMITED) 6 May 1971 see the whole document ---	1-9, 16-17, 19-29, 36-38
X	WO,A,8 707 891 (CEDONA PHARMACEUTICALS B.V.) 30 December 1987 see page 2 see page 4; example XII see page 6, line 25 - line 31 --- -/-	1,13-14, 18-19, 33-34, 36-37

¹⁰ Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

¹¹ "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention¹² "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step¹³ "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.¹⁴ "A" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search

Date of Mailing of this International Search Report

17 JUNE 1992

30.07.92

International Searching Authority

Signature of Authorized Officer

EUROPEAN PATENT OFFICE

DE BUYSER I.A.F.

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	EP,A,0 129 033 (POLAROID CORPORATION) 27 December 1984 see page 13 - page 15 see page 36; example IV see page 37; example VI see page 38; example VIII see page 40; examples X,XI ---	1
A	EP,A,0 041 359 (SMITH KLINE & FRENCH LABORATORIES LIMITED) 9 December 1981 ---	
A	DE,A,2 433 625 (SMITH KLINE & FRENCH LABORATORIES LIMITED) 30 January 1975 ---	
A	FR,A,2 311 536 (SMITH KLINE & FRENCH LABORATORIES LIMITED) 17 December 1976 ---	
A	US,A,4 262 125 (AMERICAN HOME PRODUCTS CORPORATION) 14 April 1981 ---	
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